DIVERSITY AND DISTRIBUTION OF SPIDERS FROM GIBBON WILDLIFE SANCTUARY, ASSAM, INDIA

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ABSTRACT

The study describes the identification of the spider assemblages with respect to their diversity and distribution in the semi evergreen forest, Gibbon Wildlife Sanctuary, Assam, India. The paper aims to introduce this neglected Order- *Araneae* which is primarily unknown to Science particularly in Northeast India. A total of 95 species of spiders belonging to 56 genera and 18 families were recorded during the study from June-August and October-December, 2011. The species were identified using keys for Indian spiders from (Tikader, 1987; Platnick , 2011). Methodology included active searching at all layers from ground level to tree canopy layer accessible easily for hand collecting and visual surveys. This is the first attempt to report the spider assemblages and their microhabitat preferences from Assam, India. Such surveys are vital for conservation of these creatures and building a biodiversity database of this mega diverse group from a fragmented semi-evergreen forest ecosystem in Assam, India. This study is focused on the neglected diversity of spider fauna representing this semi evergreen forest.

Key words: Gibbon Wildlife Sanctuary, *Araneae*, Morphospecies, Conservation.

INTRODUCTION

The Northeastern region of India lies at the conjugation of Indo-Himalayan Biodiversity hotspot. In Northeast, Assam with the political boundary of 78,438 sq. km. is the home of a large and diverse assemblage of intermediate predator species of the order *Araneae*, or the spiders (Coddington & Levi 1991; Wise, 1993). The origin of spiders could be traced back nearly 400 million years to the Devonian period. The abundance and resemblance of the spiders to their modern descendents can be dated back to the early Tertiary period (almost 70 million years ago). Spiders have become a successful group due to the many and varied ways in their capability to use silk (Carwardine, 1995; Foelix, 1996). The state Assam and its natural heritage in some protected area like Gibbon Wildlife Sanctuary is currently experiencing slow but steady urbanization, industrialization and expansion of agriculture. Ecosystem of some species in this region is under high peril of complete annihilation owing to unsustainable human activities (Gupta, 2005). In this regards, it is very vital to improve upon the knowledge on biodiversity of these regions in order to develop proper conservation strategies and bio-monitoring systems. A major action strategy implemented for environmental conservation involves surveys for

biological monitoring systems. Such surveys usually identify environmental disturbances in a given ecosystem using selected group of organisms called bioindicators (Garg and Hippargi, 2007). Many Amphibians, Reptiles, Aves, Mammals, and Spiders are good indicators of environmental health. They play important roles in the dynamics of a specific habitat and are sensitive to habitat loss, climatic change and environmental upheavals (Daniel, 2002). In this study emphasis was laid on to specify the diversity of spiders and their potential as bioindicators of this region. In general, taxonomic studies on spiders and invertebrates of Gibbon Wildlife Sanctuary, Assam, India are comparatively few and limited. No specific extensive studies on spider diversity in this region were carried out and published. This study focuses on the spiders (Arachnida: Araneae) as a representative invertebrate fauna from this ecosystem. Data thus collected may facilitate future initiatives of biodiversity database of these species in the region.

MATERIALS AND METHODS

Study area

Gibbon Wildlife Sanctuary is a semi-evergreen forest and is among the highest protected tracts in the sub-Himalayan belt otherwise called as the "Biodiversity Hotspot". Spiders were actively searched in the different fragments of forest surrounded by small villages and tea-estates. A railway track bissects the forest into different compartments. Gibbon wildlife Sanctuary is situated in the Jorhat district of Assam, Northeast India. The Sanctuary covers an area of 19.49 sq.km. and is an important wet evergreen forest of Assam. Formerly it was called "Hollongapar Reserve Forest", that was declared as a wildlife sanctuary in 1997. The sanctuary is located at an altitude of 100-120m above sea level and the land is well drained with some few depression left after monsoon. The habitat has been classified as "Assam valley Tropical Wet Evergreen Forest" (Champion and Seth, 1968). The floristic of the habitat has been discussed by Champion and Seth (1968).

The weather in the area may be classified as subtropical hot, wet monsoon periods (May-August) and cool dry winter (September-April). Winter rains are also not uncommon. The average rainfall is around 249 cm and the average temperature varies from 5°C (min) - 38°C (max). There is extensive work on primate species in Gibbon Wildlife Sanctuary (Chetry, *et al.* 2001, 2005, 2006; Bhattacharjee, *et al.* 2004). The forest holds the important populations of Hoolock Gibbon (*Hoolock hoolock*), Capped Langur (*Trachypithecus pileatus*), Rhesus Macaque (*Macaca mulatta*), Assamese Macaque (*Macaca assamensis*), Pig tailed Macaque (*Macaca leonina*), Slow loris (*Nyctecebus bengalensis*) and Stump-tailed macaque (*Macaca arctoides*). Insect and arachnid fauna of Gibbon forest provide protein biomass to the arboreal animals particularly to the arboreal primates (Chetry *et al.* 2006). Beside Primates, the rich diversity is reported with 489 species of plants and more than 300 species of birds and large population of butterflies (Jorhat Forest Division, Assam, India).

Fig 1: Map of Assam

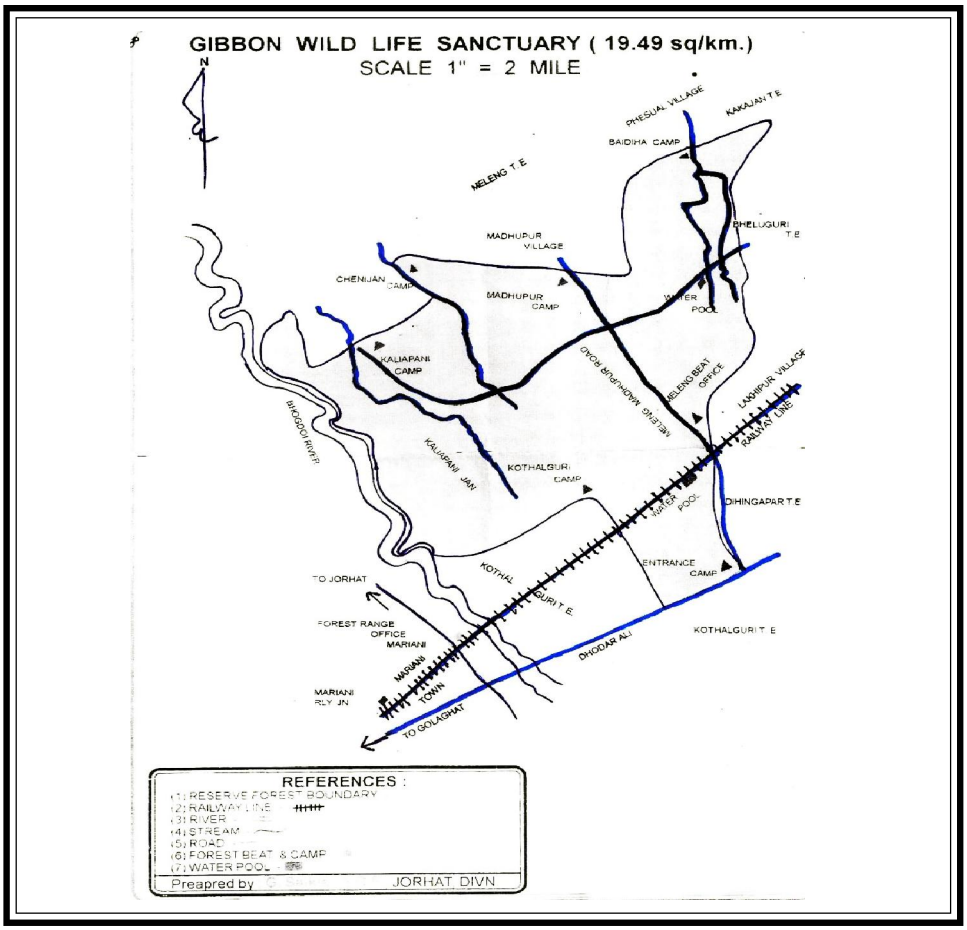

Fig. 2, Map of Gibbon Wildlife Sanctuary, Assam (Forest Division, Jorhat,Assam).

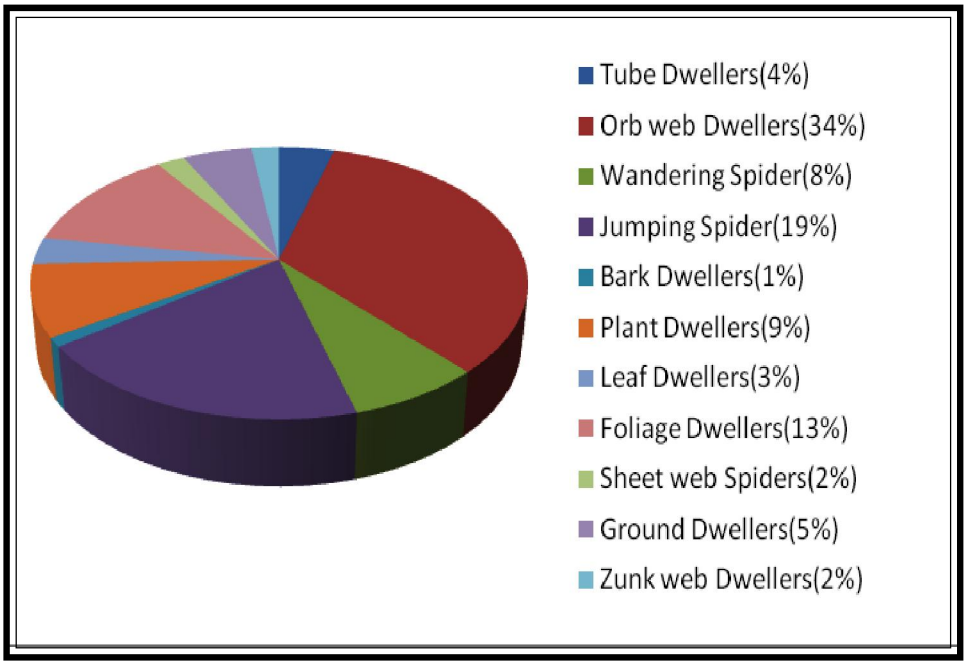

Fig 3: Comparative density (percentage) of spiders recorded during the study.

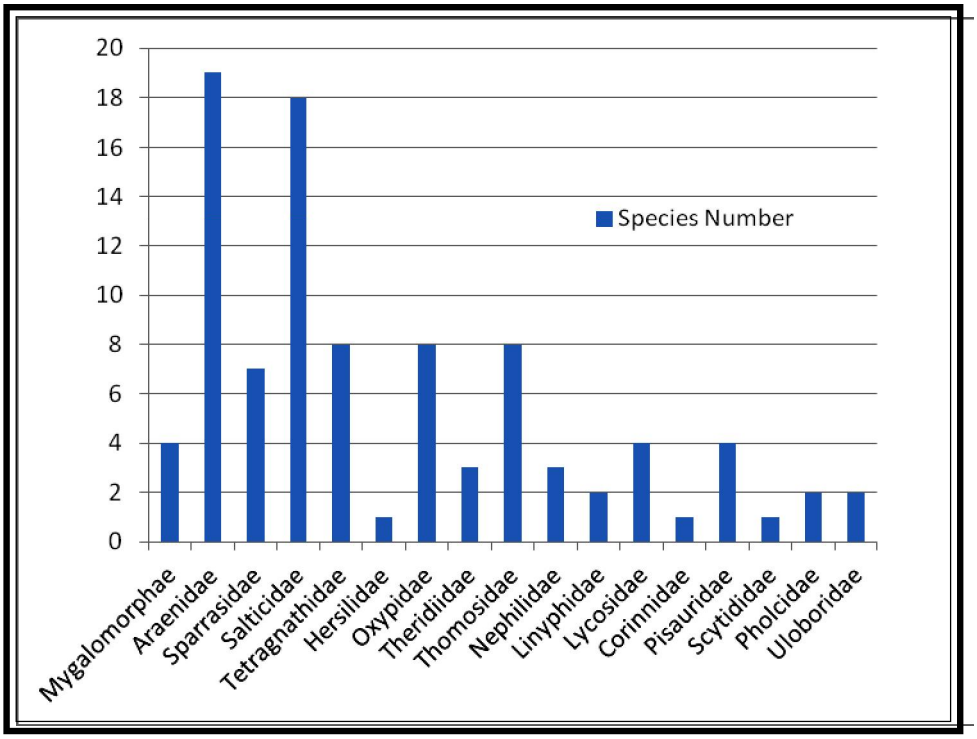

Fig 4: Graph of spiders and their numbers recorded during the study.

Table 1: Geographical location of the study area

Survey area	Longitude	Latitude
Compartment No. 1	26°40'30.10ºN	094°21'11.50ºE
Compartment No. 2	26°41'05.30ºN	094°20'39.15ºE
Compartment No. 3	26°41'50.05ºN	094°20'30.05ºE
Compartment No. 4	26°41'47.05ºN	094°20'43.35ºE
Compartment No. 5	26°41'03.35ºN	094°21'13.05ºE

Sampling

Line transects were used to search the spiders in different compartments. Transects were chosen in random with semi-quantitative sampling methods to record the spiders. Spiders were searched for maximum two hours (0900-1100 hrs) in each compartment, extending the search with different compartment sizes. The sampling was carried for two months each from June-August 2011 and October-December 2011. The sampling methods includes-visual searching for the spiders as far distinct vision is possible. Ground search were done under leaf litter or fallen dry wood. Sweep netting was done for the foliage dwelling spiders covering the herbs and shrubs. Beating trap was done with a wooden stick and an umbrella placed under the branches of small trees to catch the spiders which were unable to reach or seen hanging above. Web pattern, habitat type were recorded with every encounter. The caught spiders were placed separately in vials with 70% ethyl alcohol. The collection date, compartment number and habitat were recorded on each vial.

Spiders were identified up to the species level using the identification keys by (Tikader, 1987; Pocock, 1900). Immature spiders together with insufficient knowledge and identification keys were classified up to the morphospecies level (Oliver & Beattie, 1996; Krell, 2004). A general list of spiders recorded in study area during the survey period is enlisted in (Table 2). (Tikader, 1987 and Platnick, 2011) was followed for the taxonomic classification of the spiders.

RESULTS AND DISCUSSION

During the study, species were recorded, belonging to 18 families (Table 2) that represent 30 % of the total families reported from India. Most species of spiders found belonged to family Salticidae and Araenidae. *Argiope pulchella* was found to be the most abundant species in this region followed by *Nephila pilipes, Plexippus paykulli, Oxyopes javanus, Herennia multipunctata* etc. Out of total spider species recorded, about 38 % were found to be web builders, 62 % were ground wanderers. The unidentified species were properly labeled as morphospecies (1,2,3..etc,.) and photographed for identification. The pattern of web building, egg laying, egg sac, feeding, and reproduction were noticed for different species and properly recorded.

The spider fauna of India is represented by 1520 spider species belonging to 377 genera and 60 families (Sebastian and Peter, 2009). The present study represents 18 families, 56 genera and 95 species arranged on their foraging behavior in the field. The distribution of some families was found to be continuous (Araenidae, Salticidae, Tetragnathidae etc), while some had very discontinuous distribution. Coloration in spiders varies extensively among the species due to different environmental effects which also is due to different behavioral pattern observed on them (Oxford and Gillespie 1998; Craig and Ebert 1994; Huber, 2002; Hoese, *et al.* 2006).

Family diversity:

Araenidae (19 species) and Salticidae (18 species) occupy maximum number of species whereas Tetragnathidae (8 species), Oxypidae (8 species), Thomisidae (8 species), Sparrasidae (7 species) covers the middle order of species diversity. Mygalomorphae (4 species), Lycosidae (4 species), Pisauridae (4 species), Theridiidae (3 species), Nephilidae (3 species), Linyphidae (2 species), Pholcidae (2 Species), Uloboridae (2 species), Hersilidae (1 species), Corinnidae (1 species) and Scytodidae (1 species) are also observed during the present study.

Generic diversity

India represents 377 genera (Sebastian and Peter 2009) from which 56 genera are recorded in Gibbon Wildlife Sanctuary during the study. Highest generic diversity is found in Salticidae (15), Araenidae (10), Thomisidae (6) and Tetragnathidae (4).

Species richness

India accounts with 1520 spider species and 95 species are recorded from Gibbon Wildlife Sanctuary in 19.49 sq.km. area during the present study. This record is high compared with other records like Andaman and Nicobar islands (65 species), Sikkim (55 species) and Calcutta (99 species), (Tikader, 1970, 1977, 1980 ; Tikader & Biswas,1981).

Endemism

Among the 95 species recorded, *Gasteracantha dalyi, Myrmarachne orientalis, Olios milleti* are endemic to South Asia. *Neoscona bengalensis, Neoscona biswasi, Neoscona mukherjei, Oxyopes assamensis, Oxyopes pankaji, Pisaura gitae, Epeus indicus, Heteropoda nilgirina, Leucauge pondae, Tetragnatha viridorufa, Misumena vatia, Thomisus lobosus, Thomisus projectus, Xysticus minutes and Uloborus denolius* are endemic to India.

Affinities-

The spiders recorded from Gibbon wildlife sanctuary show affinities with pantropical, paleotropical, holarctic, palearctic and cosmotropical regions.The species having affinities with paleotropical region is *Leucauge decorata* (Tetragnathidae),

Table:2, Spider species recorded during the study.

Sr.No	Family	Species
1	Araneidae Simon,1895 Total Araenidae:19	*Araneus mitificus*Simon 1886 *Argiope aemulla*(Walckenaer, 1842) *Argiope pulchella* Thorell, 1881 *Cyclosa insulana* Costa 1834 *Cyclosa sps.* *Cyrtarachne sps.* *Cyrtophora citricola* (Forskål, 1775) *Cyrtophora feai* Thorell 1887 *Cyrtophora moluccensis* Doleschall, 1857 *Eriophora sps.* *Gasteracantha dalyi* Pocock 1900 *Gasteracantha diadesmia* Thorell 1887 *Gasteracantha kuhli* C.L. Koch, 1837 *Neoscona bengelensis* Tikader & Bal *Neoscona biswasi* Bhandari & Gajbe *Neoscona mukerjei* Tikader 1980 *Neoscona nautical*L.Koch 1875 *Ordagarius sps.* *Parawixia dehaani* Doleschall 1859
2	CorinnidaeKarsch, 1880 Total Corinnidae:01	*Castianiera sps.*
3	Ctenizidae Thorell, 1887 otal Ctenizidae:01	*Morphospecies sps.1*
4	Hersiliidae Thorell, 1870 Total Hersilidae:01	*Hersilia savignyi*(Lucas, 1836)
5	LinyphiidaeBlackwall, 1859 Total Linyphiidae:02	*Linyphia sps.1* *Linyphia sps.2*
6	Lycosidae Sundevall, 1833 Total Lycosidae:04	*Geolycosa urbana*O P Cambrige 1876 *Hippasa sps.* *Lycosa mackenziei*Gravely 1924 *Lycosa sps.*
7	Nephilidae Total Nephilidae:03	*Herennia multipuncta* Doleschall, 1859 *Nephila kuhlii* Doleschall, 1859 *Nephila pilipes* (Fabricius,1793)

8	Oxyopidae Thorell, 1870 Total Oxyopidae:08	*Oxyopes assamensis* Tikader 1969 *Oxyopes birmanicus* Thorell 1847 *Oxyopes javanus* Thorell, 1887 *Oxyopes lineatips*C L Koch 1847 *Oxyopes pankaji*Gajbe and Gajbe 2000 *Oxyopes rufisternum* Thorell *Oxyopes shweta*Tikader 1970 *Oxyopes sps.*
9	PholcidaeC.L. Koch, 1851 Total Pholcidae:02	*Artema atlanta*Walckanaer 1837 *Crossopriza lyoni*Blackwell 1867
10	PisauridaeSimon, 1890 Total Pisauridae:04	*Pisaura gitae* Tikader 1970 *Pisaura putiana* Barrion & Litsinger 1995 *Pisaura sps.* *Thalassius albocinctus*Doleschall 1859
11	Salticidae Blackwell, 1841 Total Salticidae:18	*Acemonea tenuipes* *Bavia sps.* *Brettus albolimbatus* Simon, 1900 *Carrhotus viduus* CL Koch 1846 *Cosmophasis umbrotica* Simon 1903 *Cosmophasis umbrotica* Simon 1903 *Epius indicus*Proszynski 1992 *Hasarius adansoni* Savigny et Audwin 1825 *Menemerus bivittatus* Dufour 1831 *Myrmarachne mathewei* Mathew 2007 *Myrmarachne orientalis* Tikader, 1973 *Myrmarachne plataleoides* O.P.-Cambridge, 1869 *Phintella vittata* C.L. Koch, 1846 *Plexippus paykulli male* (Audouin, 1826) *Plexippus paykulli female* (Audouin, 1826) *Portia assamensis* Wanless, 1978 *Rhene rubrigera* Thorell 1887 *Telamonia dimidiata male* Simon, 1899 *Telamonia dimidiata female* Simon, 1899 *Thiania bhamoensis* Thorell 1887 *Thiania sps.*
12	ScytodidaeBlackwall, 1864 Total Scytodidae:01	*Scytodes thoracica* Latreille 1802

13	Sparassidae Bertkau, 1872	*Heteropoda venatoria* Linnaeus 1767
	Total Sparassidae:07	*Heteropoda nilgirina* Pocock 1901
		Heteropoda sps.1
		Heteropoda sps. 2
		Neosparassus milleti
		Neosparassus sps.
		Olios milleti Pocock, 1901
14	TetragnathidaeMenge, 1866	*Leucauge decorata*(Blackwall, 1864)
	Total Tetragnathidae:08	*Leucauge pondae*Tikader 1970
		Leucauge tessellate (Thorell, 1887)
		Leucauge venusta Walckenaer 1842
		*Opadometa fastigata*Simon 1877
		*Tetragnatha mandibulata*Walckenaer 1842
		*Tetragnatha viridorufa*Gravely 1921
		Tylorida striata P Sebes
15	TheraphosidaeThorell, 1870	*Morphospecies sps.1*
	Total Theraposidae:03	*Morphospecies sps.2*
		Morphospecies sps.3
16	TheridiidaeSundevall, 1833	*Chrysso nigra* OP Cambridge,1880
	Total Theridiidae:03	*Chrysso pulcherrimus* Mello-Leitas 1917
		Steatoda sps.
17	ThomisidaeSundevall, 1833	*Amyciaea forticeps* O.P. Cambridge, 1873
	Total Thomisidae:08	*Camaricus formosus*Thorell 1887
		Misumena vatia
		Oxytate sps.
		Oxytate virens Thorell 1891
		Thomisus lobosus Tikader, 1965
		Thomisus projectus Tikader 1960
		Xysticus minutes Tikader 1960
18	UloboridaeThorell, 1869	*Uloborus danolius* Tikader
	Total Uloboridae:02	Zosis sps. 1

Total Families: 18 *Total Genera:* 56 *Total Species:* 95

pantropical *Heteropoda venatoria* (Sparassidae), *Menemerus bivittatus* (Salticidae), *Artema atlanta* (Pholcidae), holarctic *Scytodes thoracica* (Scytodidae), palearctic, *Oxyopes lineatus* (Oxyopidae) and cosmotropical *Neoscona nautica* (Araenidae). *Gasteracantha geminata* (Araenidae), *Asemonea tenuipes, Myrmarachne plataleoides (*Salticidae*)* and *Olios milleti (*Sprassidae*)* show affinities with the species of Sri Lanka.

CONCLUSION

Study on spiders is completely untouched in Assam, Northeast India. Checklist or records to these spiders are not yet prepared. Thus the study is the baseline information over the ecology, importance and the threats faced by the spider species. The rich floral and faunal diversity in the Sanctuary is the key to build the microhabitats of different species. Structurally more complex herbs and shrubs can support a more diverse spider community. The study will also help to work for the conservation of the species and specify the hidden benefits in them. Thomisids, Oxyopids, Salticides, Uloborids, Tetragnathids etc., are some of the expert silent predators in the tea and paddy ecosystems that are seen feeding on small insects like moths, butterflies, beetles, aphids, hoppers etc. (Ford, 1977, Rypstra and Carter 1995). They are maintaining ecological equilibrium by suppressing insect pest (Hazarika and Chakraborti, 1998). Thus efforts can be laid to rear spiders and use them as biocontrolling media. The pesticides used in the tea plantation are seen to be a death factor of the spiders that resides in or around the tea plantations. Highly fragmented territory of the spiders acts as a barrier for dispersal form one compartment to the other around the sanctuary (Bonte, *et al.* 2004). It is also seen that adaptation to the various environment has facilitated them to survive in broad functional groups.

There is lack of information on ecology and taxonomy of Indian Spiders. However spiders can be used as indicator species (Kapoor, 2008; Noss, 1990). Certain factors like distribution and relationship of them to the various habitats, and its responses to the different disturbance makes difficult, using them as indicator species. The study shows information related to the species distribution in a particular habitat with response to environment, disturbance, and availability of food.

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